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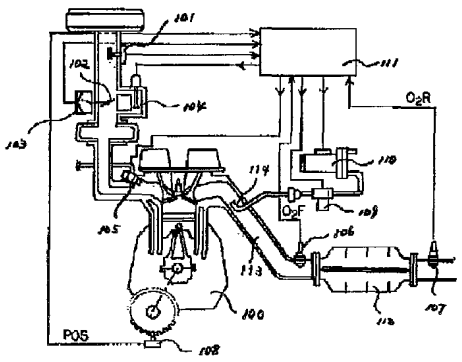
(54) SECONDARY AIR SUPPLYING CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE AND AUTOMOBILE PROVIDED THEREWITH

(57) Abstract:

PURPOSE: To provide a secondary air supplying control device for an internal combustion engine in which a secondary air supplying means is controlled based on the activation of a catalyst device, the activation of the catalyst device can be judged accurately enough, and the secondary air supplying rate is controlled always in a precise manner.

CONSTITUTION: Signals are inputted from a front oxygen sensor 106 arranged on an inlet side of a catalytic converter rhodium 112 and a rear oxygen sensor 107 arranged on an outlet side thereof. Activation of the catalytic converter rhodium is judged based on relation of the signals by means of a control device 111, and operation of a secondary air supplying pump 110 is controlled. It is thus possible to accurately obtain an activation timing of the catalytic converter rhodium 112, to stop the pump 110 at a precise time and to suppress wasteful operation of the pump with certainty.



CLAIMS

[Claim(s)]
[Claim 1]A catalyst device for exhaust air purification.
A secondary air supply means for activating this catalyst device.
An activation judging means which is a secondary air supply control device of an internal-combustion engine provided with the above, compares description of exhaust air by an entrance side and an outlet side of said catalyst device, and judges activation of said catalyst device is established, It constituted so that said secondary air supply means might be controlled by a decision result of this activation judging means.

[Claim 2]A secondary air supply control device of an internal-combustion engine characterized by description of said exhaust air being an oxygen density in an invention of claim 1.
[Claim 3]In an invention of claim 2, a means to detect said oxygen density is the 1st and the 2nd oxygen sensor which were installed in an exhaust route of an entrance side of said catalyst device, and an outlet side, respectively, and said activation judging means, A secondary air supply control device of an internal-combustion engine constituting so that activation may be judged by correlation of an output of these [1st] and the 2nd oxygen sensor.
[Claim 4]An invention of claim 3 which is provided with the following and characterized by being constituted so that said correlation may be given with the output of this exclusive OR means.
The said 1st, 1st [which binary-ize an output of the 2nd oxygen sensor, respectively], and 2nd binary-ized means.
An exclusive OR means which considers an output of these [1st] and the 2nd binary-ized means as the 1st and the 2nd input.

[Claim 5]Said activation judging means is provided with a means to detect a start-up start time of an internal-combustion engine, in an invention of claim 1, A secondary air supply control device of an internal-combustion engine constituting so that said secondary air supply means may be controlled to a halt condition when a decision result of said activation will be in an affirmation state after controlling said secondary air supply means from a start-up start time to an operating state.
[Claim 6]A secondary air supply control device of an internal-combustion engine characterized by said 1st [the] and the 2nd oxygen sensor being oxygen sensors for functional diagnoses of said catalyst device in an invention of claim 3.

[Claim 7]A car provided with a secondary air supply control device of which internal-combustion engine according to claim 1 to 6.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]In this invention, it has a catalyst device for exhaust gas purification, and secondary air is supplied at the time of engine start.
Therefore, the device which promoted activation of the catalyst device is started, especially it is related with the secondary air supply control device of the suitable internal-combustion engine for the engine system for cars using a three-way catalytic converter.

[0002]
[Description of the Prior Art]In order to exhibit the purification function (catalyst transformation efficiency) in which the catalyst device for emission gas purification (catalytic converter) is planned, it is necessary to maintain the minimum temperature (it is called catalytic activation temperature Tc) **** set up but, and. The temperature of this catalyst device is maintained at catalytic activation temperature Tc by the temperature of exhaust gas, after operation of an engine begins and time passes in a certain grade.
[0003]However, at the time of engine start, the temperature of a catalyst device is low and required catalyst transformation efficiency cannot be acquired immediately after. Then, when such, air (it is called secondary air) is supplied during engine exhaust air, the unburnt glow gas (hydrocarbon) under exhaust air is burned by this, and catalytic activation temperature Tc is made to be obtained for a short time.
[0004]By the way, in order to perform efficiently emission gas purification by such secondary air supply. Since it became conditions that the ratio of the non-combustion gas ingredient under exhaust air and this secondary air is 14.7 or more, he was trying to usually give a margin to the pump for secondary air supply supposing the quantity of the unburnt glow gas of a under [this exhaust air], so that sufficient quantity of secondary air can be supplied to it.
[0005]However, since the air of quantity with a margin will be supplied regardless of the actually needed secondary air content in this case, Since useless air will be supplied and an air pump with big capacity is needed, there are problems, such as bringing about increase of cost or a mounting space.
[0006]Then, for example in JP,56-23510,A. Form an air fuel ratio sensor in the secondary air supply port lower stream of an exhaust route, and it is indicating about the method of controlling a secondary air flow rate so that the air-fuel ratio in this portion is kept at 14.7, In JP,62-90919,U, the temperature of a catalyst device is detected, and if this detected temperature becomes beyond a predetermined temperature, it will

indicate about the device which stops secondary air supply.
[0007]
[Problem(s) to be Solved by the Invention]By the former method, consideration is not carried out among the above-mentioned conventional technologies about activation of the catalyst device by combustion of the unburnt glow gas within the catalyst device which is downstream from an air fuel ratio sensor, After a catalyst device is activated, there is a problem of a transformation efficiency fall of a catalyst with the secondary air which became superfluous, and in the device of the latter of another side and the above-mentioned conventional technologies. Neither influence by the temperature of exhaust gas nor consideration about a point which newly requires a temperature sensor was carried out, but there was a problem that the detection at the exact secondary air supply time was difficult, and became a cost hike.
[0008]The purpose of this invention controls a secondary air supply means based on activation of a catalyst device, and activation of a catalyst device can judge it correctly enough at this time, and there is in providing the secondary air supply control device of the internal-combustion engine with which always exact secondary air supply control was obtained.
[0009]
[Means for Solving the Problem]Said purpose compares description of exhaust air by an entrance side and an outlet side of a catalyst device, establishes an activation judging means which judges activation of a catalyst device from this comparison result, and controls a secondary air supply means by a decision result of this activation judging means.
[0010]
[Function]If the catalyst device is activated, the difference planned by the entrance side and outlet side at the description of exhaust air should appear. Then, since activation can be judged correctly and a secondary air supply means is controlled by this decision result by comparing the description of exhaust air by the entrance side and outlet side of these catalyst devices, exact secondary air flow rate control will be obtained.

[0011]
[Example]Hereafter, the example of a graphic display explains the secondary air supply control device of the internal-combustion engine by this invention in detail. Drawing 1 is an example of the engine system for cars with which one example of this invention was applied, The heat type air meter 101 which 100 is an internal-combustion engine (engine) and measures the mass flow rate of suction air quantity to this in this drawing 1, Suction air quantity. The throttle valve 102 to adjust and the angle signal of this throttle valve 102. The number of rotations at the time of the throttle valve opening sensor 103 to output and an idol. The pump 110 for secondary air supply, etc. are formed in the idle speed control valve 104 to control, the fuel injection valve 105 which supplies fuel to an internal-combustion engine, the 108 or secondary crank angle degree sensor air supply cutoff valve 109 which detects the number of rotations of an internal-combustion engine, and it.
[0012]Therefore, if the pump 110 operates, future air will be supplied to the secondary air supply port 114 which is carrying out the opening into the exhaust pipe 113 via the cutoff valve 109, will blow off from here in the exhaust pipe 113, and will come to work as secondary air. And when the cutoff valve 109 has a function as a cross valve and it is controlled by the opened condition at this time, the pump 110 is made to open the secondary air supply port 114 for free passage, but in a cut off state, it operates so that the air supply port

114 may be made to open for free passage in the atmosphere.

[0013]Next, 111 is a combustion engine control device and incorporates the signal from each sensor, These signals detect the operational status of an internal-combustion engine, the fuel quantity which an internal-combustion engine requires in the procedure beforehand defined according to these detection results is calculated, and it serves to carry out drive controlling of various kinds of actuators, such as the fuel injection valve 105.

[0014]112 is a three way component catalyst (catalyst device), and serves to purify exhaust gas by oxidation reduction. And the front oxygen sensor (the 1st oxygen sensor) 106 is installed upstream of this three way component catalyst 112, It serves to detect the oxygen density in the exhaust gas in the entrance side of the three way component catalyst 112, similarly downstream the back oxygen sensor (the 2nd oxygen sensor) 107 is installed, and it serves to detect the oxygen density in the exhaust gas in the outlet side of the three way component catalyst 112. And each output signal of these before oxygen sensor 106 and the back oxygen sensor 107 is incorporated into the control device 111.

[0015]Drawing 2 is what showed the internal circuit block of the combustion engine control device 111, The signal from the various sensor in above-mentioned drawing 1 is inputted, The driver circuit 201 which serves to change a small signal into the Taishin item of an actuator drive, the input output circuit 202 which obtains the work which changes an input output signal into an analogue-to-digital signal so that digital data processing can be performed, the microcomputer which performs digital data processing, Or the arithmetic circuit 203 which holds the arithmetic circuit according to it, various kinds of constants and variables which are used also for data processing of this arithmetic circuit 203, And it comprises ROM204 which is a nonvolatile memory which stores an operation procedure, RAM205 which are volatile memories, the backup circuit 206 which holds the contents of RAM205 to it, etc.

[0016]In this example, as a signal inputted into the combustion engine control device 111, The detecting signal of the heat type air meter 101, and the detecting signal of the throttle valve opening sensor 103, As a signal which among each detecting signal of the front oxygen sensor 106 and the back oxygen sensor 107, and them are the detecting signal from the crank angle degree sensor 108, etc., and is outputted from the combustion engine control device 111, The driving signal of the fuel injection valve 105, an ignition-timing signal, the idle speed control signal over the idle speed control valve 104, There are a secondary air supply pump relay driving signal which controls operation and a stop of the pump 110, a cutoff valve driving signal which controls the secondary air supply cutoff valve 109 to it, etc.

[0017]Drawing 3 is a characteristic figure showing the catalyst temperature of the three way component catalyst 112, and a relation with catalyst transformation efficiency, and it turns out that catalyst transformation efficiency changes rapidly before and behind catalytic activation temperature Tc so that clearly from this figure.

[0018]Then, when an engine is started and the change of the output signal of the front oxygen sensor 106 and the output signal of the back oxygen sensor 107 to change of the catalyst temperature of the three way component catalyst 112 is seen, using the pump 110, opening the cutoff valve 109, and supplying secondary air now, it comes to be shown in drawing 4. Namely, after engine start, as shown in this drawing 4, although catalyst temperature rises one by one, Until that temperature reaches catalytic activation temperature Tc at this time, If it becomes to correlation strong against change of the output signal of the front oxygen sensor 106 and the output signal of the back oxygen sensor 107 being seen more than this

catalytic activation temperature Tc, correlation between the output signal of the front oxygen sensor 106 and the output signal of the back oxygen sensor 107 will be lost quickly.

[0019]This is because catalyst conversion with secondary air and unburnt glow gas will come to progress efficiently and an oxygen density will fall by the outlet side of the three way component catalyst 112 as a result, if the three way component catalyst 112 is activated. If it puts in another way and the three way component catalyst 112 will come to exhibit an original function, by the reducing action by the catalyst in the inside of it, or the oxidation. He is because the description of the exhaust gas in an outlet side differs from the description of the exhaust gas in an entrance side, and is trying to judge activation of a catalyst device in this invention by the difference between the description of the exhaust gas in the entrance side of this catalyst device, and the description of the exhaust gas in an outlet side.

[0020]Drawing 5 is what showed the relation of the content (discharge HC) of the hydrocarbon in the inside of the exhaust gas in the outlet side of the three way component catalyst 112, and a secondary air content required for combustion of this, At the engine start-up time, since catalyst temperature is low immediately after t_0, hydrocarbon is not purified within a catalyst but, for this reason, a lot of secondary air is required. However, since combustion of the hydrocarbon by a catalyst begins by t_2 the time of catalyst temperature rising and reaching catalytic activation temperature Tc after that, and the amount required of secondary air decreases and is carried out, Stop the pump 110 here, and close the cutoff valve 109, the air supply port 114 is made to open for free passage in the atmosphere, and it turns out that combustion purification of hydrocarbon is attained only with the secondary air supply obtained by natural aspiration.

[0021]Therefore, although the exact judgment of t_2 will be required the time of this catalyst reaching activation temperature Tc for the secondary air supply control with this pump, By this invention, since it is certainly detectable that could judge activation of the catalyst device correctly as mentioned above, and catalyst temperature reached catalytic activation temperature Tc, the pump 110 and the cutoff valve 109 are controlled by this decision result to the exact timing shown in this drawing 5.

[0022]For this reason, in the example shown in drawing 1 and drawing 2, as the control device 111 is shown in drawing 6, it incorporates the signal from the two oxygen sensors 106 and 107. That is, the signal from each sensor of the front oxygen sensor 106 and the back oxygen sensor 107 is incorporated via the zener diode 603 for excess voltage prevention, after passing along the first-order-lag filter which comprises the resistance 601 and the capacitor 602, respectively.

[0023]In this way, the incorporated signal is the arithmetic circuit 203 and digital filter processing is performed by the operation shown in the following several 1.

[0024]

[Equation 1]

【数１】

$$O_2ad(S)=\frac{1}{1+ST}\cdot O_2(S)\cdots\cdots \qquad \cdots\cdots(式1-1)$$

$$O_2ad(n)=WEIGHT\cdot O_2ad(n-1)+(1-WEIGHT)\cdot O_2(n)\cdots\cdots(式1-2)$$

[0025]This several 1 formula 1-1 shows filtering in contiguous areas, and the formula 1-2 shows filtering in

the discrete region. WEIGHT in the formula 1-2 shows weighting by a weighted average efficiency.

[0026]Drawing 7 is what showed the logic of the secondary air supply control management by the arithmetic circuit 203, and a crank angle degree signal, O_2F, and O_2R of POS are the signals of the front oxygen sensor 106 and the back oxygen sensor 107 in this figure, respectively.

ST shows the ON signal of the starter for engine start.

Signal O_2F from each oxygen sensor and O_2R are first changed into digital value by A/D(analog-to-digital converter) 705 and 706, Subsequently, it is compared with threshold O_2SL given from the threshold generation element 709 by the comparison elements 707 and 708, and is normalized.

[0027]Next, since signal O_2R from the back oxygen sensor 107 has a part for the transport lag within the catalyst of exhaust gas as compared with signal O_2F from the front oxygen sensor 106, signal O_2F from the front oxygen sensor 106 is delayed by this transport lag with the delay element 710. The time delay Tn at this time searches the table 704 with crank angle signal POS, and is found. In this way, the signal with which processed each signal O_2F and O_2R are inputted into the exclusive OR element 711, and a mutually related degree is expressed from this exclusive OR element 711 as a result, i.e., correlation signal EO_2, is outputted.

[0028]Although integration treatment of the correlation signal EO_2 of the exclusive OR element 711 is carried out with the integral element 716, The limits of integration at this time are determined by reset-signal RESET generated in the definite angle SPOS of the degree of crank angle given from the comparison element 702, and This sake, It has the reference-value generation element 701 which generates the definite angle SPOSL, and the integral element 703, and these outputs are inputted into the above-mentioned comparison element 702. Although the limits of integration are decided to have described above with the degree of crank angle in this example, it may be made to become at fixed time set beforehand.

[0029]Integration signal SO_2 which is an output of the integral element 716 is inputted into the comparison element 715, As compared with threshold CL given from the threshold generation element 714 here, it judges with the catalyst having been activated when exceeding threshold CL, The output signal of the comparison element 715 is supplied to the switch element 713, the output RELAY by this is intercepted, operation of the pump 110 is suspended, the cutoff valve 109 is closed simultaneously, and it controls in the state after t_2, i.e., the secondary air supply state by natural aspiration, at the time of drawing 5.

[0030]On the other hand, although starting of the output RELAY by the switch element 713 in an engine start time is given by ON input of signal ST of the starter for engine start, In this example, the delay element 712 is formed and the delay which is equivalent to the above-mentioned transport lag also about this signal ST is given.

[0031]After starter signal ST for engine start which drawing 8 is a timing chart of the signal in each portion of drawing 7, and is not illustrated turns on by time t_0, The signal RELAY by the switch element 713 rises by time t_1 after the time delay progress by the delay element 712, operation of the pump 110 begins, the cutoff valve 109 is opened, and secondary air supply carries out the start skirt, and At this time. Since secondary air is supplied from the pump 110 and hydrocarbon burns by this, the rise in heat of the three way

component catalyst 112, i.e., activation, comes to be promoted.

[0032]However, at the start time, the temperature of the three way component catalyst 112 is low, and still close to ordinary temperature immediately after. Therefore, correlation with signal O_2F from the front oxygen sensor 106 and signal O_2R from the back oxygen sensor 107 appears strongly for a while after this time (like a graphic display). In order that the purification function by this catalyst may begin to work as the temperature of the three way component catalyst 112 rises soon although correlation signal EO_2 which shows the same action is almost hardly generated, A difference appears in the action of signal O_2F and signal O_2R, correlation signal EO_2 sometimes occurs in connection with this, and integration signal SO_2 comes to increase little by little.

[0033]And since most correlation of signal O_2F and signal O_2R will be lost like a graphic display if the three way component catalyst 112 is activated, Since the signal RELAY which the level of integration signal SO_2 increased rapidly, and the signal occurred from the comparison element 715 in time t_2 in which it exceeded threshold CL, and was outputted from the switch element 713 by this falls, Since operation of the pump 110 is suspended certainly in the place where this time $t_2$112, i.e., a three way component catalyst, was activated, the cutoff valve 109 will be closed and operation of the pump 110 can be suspended to always exact timing, operation of a useless pump can be suppressed certainly.

[0034]Next, drawing 9 explains other examples of this invention. The example of this drawing 9 is what applies a correlation coefficient calculation method and judged activation of the catalyst device, and signal O_2F from each oxygen sensor and O_2R are changed into digital value by A/D903 and 904 like the example of drawing 7, respectively. And transport lag amendment is performed to signal O_2F from the front oxygen sensor 106 with the lag unit 905. Too, like the example of drawing 7, the time delay Tn at this time searches the table 902 with crank angle signal POS, and is found.

[0035]906 is a correlation coefficient calculation element and calculates correlation of signal O_2F from each oxygen sensor, and O_2R by several 2 shown below.

[0036]

[Equation 2]

【数2】

$$\langle O_2F(\tau)\cdot O_2R(\tau)\rangle=\int_{-\infty}^{\infty} O_2F(t)\cdot O_2S(t+\tau)\,dt \cdots\cdots$$

……(式2－1)

$$\langle O_2F(m)\cdot O_2R(m)\rangle=\frac{1}{D\cdot\sigma_{O_2F}\cdot\sigma_{O_2R}}\sum_{n=0}^{D-1} O_2F(n)\cdot O_2R(n+m)$$

……(式2－2)

$$D=f(N)=T \cdots\cdots$$

……(式2－3)

[0037]In this several 2, although the equation 2-1 is a formula in contiguous areas, since digital calculation processing is adopted as shown in drawing 2, in this example, it calculates using the formula in the discrete region shown in the equation 2-2. And the calculation section D at this time is given with the function of the engine number of rotations N, as shown in the formula 2-3.
For this reason, the table 901 is searched with crank angle signal POS, and it asks for it.

[0038]In this way, the correlation coefficient calculated with the correlation coefficient calculation element 906, It is compared with threshold LC given from the threshold generation element 910 by the comparison element 909 like the example of drawing 7 after all, If threshold CL is exceeded, will judge with the catalyst having been activated, and the output signal of the comparison element 909 is supplied to the switch element 908, The output RELAY by this is intercepted, operation of the pump 110 is suspended, the cutoff valve 109 is closed simultaneously, and it controls in the state after t_2, i.e., the secondary air supply state by natural aspiration, at the time of drawing 5.
[0039]On the other hand, although starting of the output RELAY by the switch element 908 in an engine start time is given by ON input of signal ST of the starter for engine start, Also in this example, delay equivalent to the above-mentioned transport lag is given about this signal ST as well as the example of drawing 7 with the delay element 907.
[0040]Therefore, also according to the example of this drawing 9, activation of the three way component catalyst 112 can be judged correctly, and the pump 110 for secondary air supply and exact control of the cutoff valve 109 can be obtained.
[0041]Next, a flow chart explains operation of the above example in detail. First, drawing 10 is a general flowchart which shows operation of the example of drawing 7, and judges whether the engine starter is turned on at Step 1201. And if turned on, a pump-on flag will be set to 1 at Step 1202.
[0042]Hereafter, sequential execution of the processing from Step 1204 to Step 1211 is carried out. That is, the output voltage of each oxygen sensor of order is incorporated from A/D (Steps 1204 and 1205). Crank angle signal POS is incorporated (Step 1206), the time delay which should calculate engine number of rotations and should be given to the signal of a front oxygen sensor is calculated (Step 1207), and a signal is delayed (Step 1208).
[0043]In Step 1209, the exclusive OR of the signal processed from each oxygen sensor is taken, Perform integration between fixed crank angle degree hours at Step 1210, when this integrated result is below a predetermined value (threshold) at Step 1213, carry out the relay (pump relay) which controls the pump 110 and the cutoff valve 109 by Step 1214 to one, but. since a starter is turned on at Step 1212 at this time -- eye **** -- a law -- it is investigated whether ****** fixed time passed. This does not make one the pump 110 for secondary air supply simultaneously with the function by the delay element 712 of drawing 7, i.e., the engine start start by a starter, It is for making it delayed and making it one, and this time delay is given an engine temperature as a parameter by making engine number of rotations into a parameter like the example of drawing 7.
[0044]On the other hand, when it is judged that fixed time lapse has not been carried out at Step 1212, a pump relay is turned off at Step 1216 and processing is ended. When an integrated value is judged to be beyond a threshold at Step 1213, by Step 1215, a pump-on flag is set to 0, a pump relay is continuously

turned off at Step 1216, and processing is ended. On the other hand, in this example, Step 1203 is formed, and thereby, unless a starter is again made one next, a pump relay was not controlled by one and has come.

[0045]Next, drawing 11 is a general flow chart which shows operation of the example of drawing 9, it only differs from the case of drawing 10 in that processing at Step 1308 is processing by the correlation coefficient calculation element 906 in drawing 9, and since other processings are the same, detailed explanation is omitted.

[0046]Although activation of a catalyst device is judged and he is trying to control secondary air supply by the above example appropriately, since time until a catalyst is activated has that degradation and relation, the grade of degradation of a catalyst can also be diagnosed by this time measurement.

[0047]By the way, although existence of oxygen in the inside of exhaust gas is used in the above example as description of exhaust air by the entrance side and outlet side of a catalyst device which are used for the judgment of activation of the three way component catalyst 112, it may replace with this and existence of HC (hydrocarbon) and CO (carbon dioxide) may be used.

[0048]

[Effect of the Invention]In this invention, the entrance side and outlet side of a catalyst device compare the description of exhaust air, and activation of the catalyst device was judged from this comparison result. Therefore, an always exact decision result can be obtained without being influenced by engine operational status etc., as a result, the stop control of the operation of the pump for secondary air supply can be certainly carried out to always exact timing, and useless operation can be suppressed.

[0049]Activation of a catalyst device is judged and secondary air supply is controlled by this invention. Therefore, the capacity of the pump for secondary air supply can be reduced, and a miniaturization and a weight saving become possible, and reduction also of the cost can be carried out.

[0050]According to this invention, it also becomes possible to consider it as the device which judged own activation and which was made intelligent with the catalyst device itself, and much more simplification of a system can be attained as an object for cars, etc.

[Translation done.]

TECHNICAL FIELD

[Industrial Application]In this invention, it has a catalyst device for exhaust gas purification, and secondary air is supplied at the time of engine start.
Therefore, the device which promoted activation of the catalyst device is started, especially it is related with the secondary air supply control device of the suitable internal-combustion engine for the engine system for cars using a three-way catalytic converter.

PRIOR ART

[Description of the Prior Art]In order to exhibit the purification function (catalyst transformation efficiency) in which the catalyst device for emission gas purification (catalytic converter) is planned, it is necessary to maintain the minimum temperature (it is called catalytic activation temperature Tc) **** set up but, and. The temperature of this catalyst device is maintained at catalytic activation temperature Tc by the temperature of exhaust gas, after operation of an engine begins and time passes in a certain grade.

[0003]However, at the time of engine start, the temperature of a catalyst device is low and required catalyst transformation efficiency cannot be acquired immediately after. Then, when such, air (it is called secondary air) is supplied during engine exhaust air, the unburnt glow gas (hydrocarbon) under exhaust air is burned by this, and catalytic activation temperature Tc is made to be obtained for a short time.

[0004]By the way, in order to perform efficiently emission gas purification by such secondary air supply. Since it became conditions that the ratio of the non-combustion gas ingredient under exhaust air and this secondary air is 14.7 or more, he was trying to usually give a margin to the pump for secondary air supply supposing the quantity of the unburnt glow gas of a under [this exhaust air], so that sufficient quantity of secondary air can be supplied to it.

[0005]However, since the air of quantity with a margin will be supplied regardless of the actually needed secondary air content in this case, Since useless air will be supplied and an air pump with big capacity is needed, there are problems, such as bringing about increase of cost or a mounting space.

[0006]Then, for example in JP,56-23510,A. Form an air fuel ratio sensor in the secondary air supply port lower stream of an exhaust route, and it is indicating about the method of controlling a secondary air flow rate so that the air-fuel ratio in this portion is kept at 14.7, In JP,62-90919,U, the temperature of a catalyst device is detected, and if this detected temperature becomes beyond a predetermined temperature, it will indicate about the device which stops secondary air supply.

EFFECT OF THE INVENTION

[Effect of the Invention]In this invention, the entrance side and outlet side of a catalyst device compare the description of exhaust air, and activation of the catalyst device was judged from this comparison result. Therefore, an always exact decision result can be obtained without being influenced by engine operational status etc., as a result, the stop control of the operation of the pump for secondary air supply can be certainly carried out to always exact timing, and useless operation can be suppressed.

[0049]Activation of a catalyst device is judged and secondary air supply is controlled by this invention. Therefore, the capacity of the pump for secondary air supply can be reduced, and a miniaturization and a weight saving become possible, and reduction also of the cost can be carried out.

[0050]According to this invention, it also becomes possible to consider it as the device which judged own activation and which was made intelligent with the catalyst device itself, and much more simplification of a system can be attained as an object for cars, etc.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]By the former method, consideration is not carried out among the above-mentioned conventional technologies about activation of the catalyst device by combustion of the unburnt glow gas within the catalyst device which is downstream from an air fuel ratio sensor, After a catalyst device is activated, there is a problem of a transformation efficiency fall of a catalyst with the secondary air which became superfluous, and in the device of the latter of another side and the above-mentioned conventional technologies. Neither influence by the temperature of exhaust gas nor consideration about a point which newly requires a temperature sensor was carried out, but there was a problem that the detection at the exact secondary air supply time was difficult, and became a cost hike.
[0008]The purpose of this invention controls a secondary air supply means based on activation of a catalyst device, and activation of a catalyst device can judge it correctly enough at this time, and there is in providing the secondary air supply control device of the internal-combustion engine with which always exact secondary air supply control was obtained.

MEANS

[Means for Solving the Problem]Said purpose compares description of exhaust air by an entrance side and an outlet side of a catalyst device, establishes an activation judging means which judges activation of a catalyst device from this comparison result, and controls a secondary air supply means by a decision result of this activation judging means.

[Translation done.]

OPERATION

[Function]If the catalyst device is activated, the difference planned by the entrance side and outlet side at the description of exhaust air should appear. Then, since activation can be judged correctly and a secondary air supply means is controlled by this decision result by comparing the description of exhaust air by the entrance side and outlet side of these catalyst devices, exact secondary air flow rate control will be obtained.

EXAMPLE

[Example]Hereafter, the example of a graphic display explains the secondary air supply control device of the internal-combustion engine by this invention in detail. Drawing 1 is an example of the engine system for cars with which one example of this invention was applied, The heat type air meter 101 which 100 is an internal-combustion engine (engine) and measures the mass flow rate of suction air quantity to this in this drawing 1, Suction air quantity. The throttle valve 102 to adjust and the angle signal of this throttle valve 102. The number of rotations at the time of the throttle valve opening sensor 103 to output and an idol. The pump 110 for secondary air supply, etc. are formed in the idle speed control valve 104 to control, the fuel injection valve 105 which supplies fuel to an internal-combustion engine, the 108 or secondary crank angle degree sensor air supply cutoff valve 109 which detects the number of rotations of an internal-combustion engine, and it.

[0012]Therefore, if the pump 110 operates, future air will be supplied to the secondary air supply port 114 which is carrying out the opening into the exhaust pipe 113 via the cutoff valve 109, will blow off from here in the exhaust pipe 113, and will come to work as secondary air. And when the cutoff valve 109 has a function as a cross valve and it is controlled by the opened condition at this time, the pump 110 is made to open the secondary air supply port 114 for free passage, but in a cut off state, it operates so that the air supply port 114 may be made to open for free passage in the atmosphere.

[0013]Next, 111 is a combustion engine control device and incorporates the signal from each sensor, These signals detect the operational status of an internal-combustion engine, the fuel quantity which an internal-combustion engine requires in the procedure beforehand defined according to these detection results is calculated, and it serves to carry out drive controlling of various kinds of actuators, such as the fuel injection valve 105.

[0014]112 is a three way component catalyst (catalyst device), and serves to purify exhaust gas by oxidation reduction. And the front oxygen sensor (the 1st oxygen sensor) 106 is installed upstream of this three way component catalyst 112, It serves to detect the oxygen density in the exhaust gas in the entrance side of the three way component catalyst 112, similarly downstream the back oxygen sensor (the 2nd oxygen sensor) 107 is installed, and it serves to detect the oxygen density in the exhaust gas in the outlet side of the three way component catalyst 112. And each output signal of these before oxygen sensor 106 and the back oxygen sensor 107 is incorporated into the control device 111.

[0015]Drawing 2 is what showed the internal circuit block of the combustion engine control device 111, The signal from the various sensor in above-mentioned drawing 1 is inputted, The driver circuit 201 which serves

to change a small signal into the Taishin item of an actuator drive, the input output circuit 202 which obtains the work which changes an input output signal into an analogue-to-digital signal so that digital data processing can be performed, the microcomputer which performs digital data processing, Or the arithmetic circuit 203 which holds the arithmetic circuit according to it, various kinds of constants and variables which are used also for data processing of this arithmetic circuit 203, And it comprises ROM204 which is a nonvolatile memory which stores an operation procedure, RAM205 which are volatile memories, the backup circuit 206 which holds the contents of RAM205 to it, etc.

[0016]In this example, as a signal inputted into the combustion engine control device 111, The detecting signal of the heat type air meter 101, and the detecting signal of the throttle valve opening sensor 103, As a signal which among each detecting signal of the front oxygen sensor 106 and the back oxygen sensor 107, and them are the detecting signal from the crank angle degree sensor 108, etc., and is outputted from the combustion engine control device 111, The driving signal of the fuel injection valve 105, an ignition-timing signal, the idle speed control signal over the idle speed control valve 104, There are a secondary air supply pump relay driving signal which controls operation and a stop of the pump 110, a cutoff valve driving signal which controls the secondary air supply cutoff valve 109 to it, etc.

[0017]Drawing 3 is a characteristic figure showing the catalyst temperature of the three way component catalyst 112, and a relation with catalyst transformation efficiency, and it turns out that catalyst transformation efficiency changes rapidly before and behind catalytic activation temperature Tc so that clearly from this figure.

[0018]Then, when an engine is started and the change of the output signal of the front oxygen sensor 106 and the output signal of the back oxygen sensor 107 to change of the catalyst temperature of the three way component catalyst 112 is seen, using the pump 110, opening the cutoff valve 109, and supplying secondary air now, it comes to be shown in drawing 4. Namely, after engine start, as shown in this drawing 4, although catalyst temperature rises one by one, Until that temperature reaches catalytic activation temperature Tc at this time, If it becomes to correlation strong against change of the output signal of the front oxygen sensor 106 and the output signal of the back oxygen sensor 107 being seen more than this catalytic activation temperature Tc, correlation between the output signal of the front oxygen sensor 106 and the output signal of the back oxygen sensor 107 will be lost quickly.

[0019]This is because catalyst conversion with secondary air and unburnt glow gas will come to progress efficiently and an oxygen density will fall by the outlet side of the three way component catalyst 112 as a result, if the three way component catalyst 112 is activated. If it puts in another way and the three way component catalyst 112 will come to exhibit an original function, by the reducing action by the catalyst in the inside of it, or the oxidation. He is because the description of the exhaust gas in an outlet side differs from the description of the exhaust gas in an entrance side, and is trying to judge activation of a catalyst device in this invention by the difference between the description of the exhaust gas in the entrance side of this catalyst device, and the description of the exhaust gas in an outlet side.

[0020]Drawing 5 is what showed the relation of the content (discharge HC) of the hydrocarbon in the inside of the exhaust gas in the outlet side of the three way component catalyst 112, and a secondary air content required for combustion of this, At the engine start-up time, since catalyst temperature is low immediately after t_0, hydrocarbon is not purified within a catalyst but, for this reason, a lot of secondary air is required.

However, since combustion of the hydrocarbon by a catalyst begins by t_2 the time of catalyst temperature rising and reaching catalytic activation temperature Tc after that, and the amount required of secondary air decreases and is carried out, Stop the pump 110 here, and close the cutoff valve 109, the air supply port 114 is made to open for free passage in the atmosphere, and it turns out that combustion purification of hydrocarbon is attained only with the secondary air supply obtained by natural aspiration.

[0021]Therefore, although the exact judgment of t_2 will be required the time of this catalyst reaching activation temperature Tc for the secondary air supply control with this pump, By this invention, since it is certainly detectable that could judge activation of the catalyst device correctly as mentioned above, and catalyst temperature reached catalytic activation temperature Tc, the pump 110 and the cutoff valve 109 are controlled by this decision result to the exact timing shown in this drawing 5.

[0022]For this reason, in the example shown in drawing 1 and drawing 2, as the control device 111 is shown in drawing 6, it incorporates the signal from the two oxygen sensors 106 and 107. That is, the signal from each sensor of the front oxygen sensor 106 and the back oxygen sensor 107 is incorporated via the zener diode 603 for excess voltage prevention, after passing along the first-order-lag filter which comprises the resistance 601 and the capacitor 602, respectively.

[0023]In this way, the incorporated signal is the arithmetic circuit 203 and digital filter processing is performed by the operation shown in the following several 1.

[0024]

[Equation 1]

【数１】

$$O_2ad(S)=\frac{1}{1+ST}\cdot O_2(S)\cdots\cdots \qquad \cdots\cdots(式1-1)$$

$$O_2ad(n)=WEIGHT\cdot O_2ad(n-1)+(1-WEIGHT)\cdot O_2(n)\cdots\cdots(式1-2)$$

[0025]This several 1 formula 1-1 shows filtering in contiguous areas, and the formula 1-2 shows filtering in the discrete region. WEIGHT in the formula 1-2 shows weighting by a weighted average efficiency.

[0026]Drawing 7 is what showed the logic of the secondary air supply control management by the arithmetic circuit 203, and a crank angle degree signal, O_2F, and O_2R of POS are the signals of the front oxygen sensor 106 and the back oxygen sensor 107 in this figure, respectively.

ST shows the ON signal of the starter for engine start.

Signal O_2F from each oxygen sensor and O_2R are first changed into digital value by A/D(analog-to-digital converter) 705 and 706, Subsequently, it is compared with threshold O_2SL given from the threshold generation element 709 by the comparison elements 707 and 708, and is normalized.

[0027]Next, since signal O_2R from the back oxygen sensor 107 has a part for the transport lag within the catalyst of exhaust gas as compared with signal O_2F from the front oxygen sensor 106, signal O_2F from the front oxygen sensor 106 is delayed by this transport lag with the delay element 710. The time delay Tn at this time searches the table 704 with crank angle signal POS, and is found. In this way, the signal with which

processed each signal O_2F and O_2R are inputted into the exclusive OR element 711, and a mutually related degree is expressed from this exclusive OR element 711 as a result, i.e., correlation signal EO_2, is outputted.

[0028]Although integration treatment of the correlation signal EO_2 of the exclusive OR element 711 is carried out with the integral element 716, The limits of integration at this time are determined by reset-signal RESET generated in the definite angle SPOS of the degree of crank angle given from the comparison element 702, and This sake, It has the reference-value generation element 701 which generates the definite angle SPOSL, and the integral element 703, and these outputs are inputted into the above-mentioned comparison element 702. Although the limits of integration are decided to have described above with the degree of crank angle in this example, it may be made to become at fixed time set beforehand.

[0029]Integration signal SO_2 which is an output of the integral element 716 is inputted into the comparison element 715, As compared with threshold CL given from the threshold generation element 714 here, it judges with the catalyst having been activated when exceeding threshold CL, The output signal of the comparison element 715 is supplied to the switch element 713, the output RELAY by this is intercepted, operation of the pump 110 is suspended, the cutoff valve 109 is closed simultaneously, and it controls in the state after t_2, i.e., the secondary air supply state by natural aspiration, at the time of drawing 5.

[0030]On the other hand, although starting of the output RELAY by the switch element 713 in an engine start time is given by ON input of signal ST of the starter for engine start, In this example, the delay element 712 is formed and the delay which is equivalent to the above-mentioned transport lag also about this signal ST is given.

[0031]After starter signal ST for engine start which drawing 8 is a timing chart of the signal in each portion of drawing 7, and is not illustrated turns on by time t_0, The signal RELAY by the switch element 713 rises by time t_1 after the time delay progress by the delay element 712, operation of the pump 110 begins, the cutoff valve 109 is opened, and secondary air supply carries out the start skirt, and At this time. Since secondary air is supplied from the pump 110 and hydrocarbon burns by this, the rise in heat of the three way component catalyst 112, i.e., activation, comes to be promoted.

[0032]However, at the start time, the temperature of the three way component catalyst 112 is low, and still close to ordinary temperature immediately after. Therefore, correlation with signal O_2F from the front oxygen sensor 106 and signal O_2R from the back oxygen sensor 107 appears strongly for a while after this time (like a graphic display). In order that the purification function by this catalyst may begin to work as the temperature of the three way component catalyst 112 rises soon although correlation signal EO_2 which shows the same action is almost hardly generated, A difference appears in the action of signal O_2F and signal O_2R, correlation signal EO_2 sometimes occurs in connection with this, and integration signal SO_2 comes to increase little by little.

[0033]And since most correlation of signal O_2F and signal O_2R will be lost like a graphic display if the three way component catalyst 112 is activated, Since the signal RELAY which the level of integration signal SO_2 increased rapidly, and the signal occurred from the comparison element 715 in time t_2 in which it exceeded

threshold CL, and was outputted from the switch element 713 by this falls, Since operation of the pump 110 is suspended certainly in the place where this time $t_2$112, i.e., a three way component catalyst, was activated, the cutoff valve 109 will be closed and operation of the pump 110 can be suspended to always exact timing, operation of a useless pump can be suppressed certainly.

[0034]Next, drawing 9 explains other examples of this invention. The example of this drawing 9 is what applies a correlation coefficient calculation method and judged activation of the catalyst device, and signal O_2F from each oxygen sensor and O_2R are changed into digital value by A/D903 and 904 like the example of drawing 7, respectively. And transport lag amendment is performed to signal O_2F from the front oxygen sensor 106 with the lag unit 905. Too, like the example of drawing 7, the time delay Tn at this time searches the table 902 with crank angle signal POS, and is found.

[0035]906 is a correlation coefficient calculation element and calculates correlation of signal O_2F from each oxygen sensor, and O_2R by several 2 shown below.

[0036]

[Equation 2]

[数2]

$$\langle O_2F(\tau)\cdot O_2R(\tau)\rangle=\int_{-\infty}^{\infty} O_2F(t)\cdot O_2S(t+\tau)dt \cdots\cdots$$

……(式2－1)

$$\langle O_2F(m)\cdot O_2R(m)\rangle=\frac{1}{D\cdot\sigma_{O_2F}\cdot\sigma_{O_2R}}\sum_{n=0}^{D-1} O_2F(n)\cdot O_2R(n+m)$$

……(式2－2)

$$D=f(N)=T\cdots\cdots \quad \cdots\cdots(式2-3)$$

[0037]In this several 2, although the equation 2-1 is a formula in contiguous areas, since digital calculation processing is adopted as shown in drawing 2, in this example, it calculates using the formula in the discrete region shown in the equation 2-2. And the calculation section D at this time is given with the function of the engine number of rotations N, as shown in the formula 2-3.

For this reason, the table 901 is searched with crank angle signal POS, and it asks for it.

[0038]In this way, the correlation coefficient calculated with the correlation coefficient calculation element 906, It is compared with threshold LC given from the threshold generation element 910 by the comparison element 909 like the example of drawing 7 after all, If threshold CL is exceeded, will judge with the catalyst having been activated, and the output signal of the comparison element 909 is supplied to the switch element 908, The output RELAY by this is intercepted, operation of the pump 110 is suspended, the cutoff valve 109 is closed simultaneously, and it controls in the state after t_2, i.e., the secondary air supply state by natural aspiration, at the time of drawing 5.

[0039]On the other hand, although starting of the output RELAY by the switch element 908 in an engine start time is given by ON input of signal ST of the starter for engine start, Also in this example, delay equivalent to the above-mentioned transport lag is given about this signal ST as well as the example of drawing 7 with the delay element 907.
[0040]Therefore, also according to the example of this drawing 9, activation of the three way component catalyst 112 can be judged correctly, and the pump 110 for secondary air supply and exact control of the cutoff valve 109 can be obtained.
[0041]Next, a flow chart explains operation of the above example in detail. First, drawing 10 is a general flowchart which shows operation of the example of drawing 7, and judges whether the engine starter is turned on at Step 1201. And if turned on, a pump-on flag will be set to 1 at Step 1202.
[0042]Hereafter, sequential execution of the processing from Step 1204 to Step 1211 is carried out. That is, the output voltage of each oxygen sensor of order is incorporated from A/D (Steps 1204 and 1205). Crank angle signal POS is incorporated (Step 1206), the time delay which should calculate engine number of rotations and should be given to the signal of a front oxygen sensor is calculated (Step 1207), and a signal is delayed (Step 1208).
[0043]In Step 1209, the exclusive OR of the signal processed from each oxygen sensor is taken, Perform integration between fixed crank angle degree hours at Step 1210, when this integrated result is below a predetermined value (threshold) at Step 1213, carry out the relay (pump relay) which controls the pump 110 and the cutoff valve 109 by Step 1214 to one, but. since a starter is turned on at Step 1212 at this time -- eye **** -- a law -- it is investigated whether ****** fixed time passed. This does not make one the pump 110 for secondary air supply simultaneously with the function by the delay element 712 of drawing 7, i.e., the engine start start by a starter, It is for making it delayed and making it one, and this time delay is given an engine temperature as a parameter by making engine number of rotations into a parameter like the example of drawing 7.
[0044]On the other hand, when it is judged that fixed time lapse has not been carried out at Step 1212, a pump relay is turned off at Step 1216 and processing is ended. When an integrated value is judged to be beyond a threshold at Step 1213, by Step 1215, a pump-on flag is set to 0, a pump relay is continuously turned off at Step 1216, and processing is ended. On the other hand, in this example, Step 1203 is formed, and thereby, unless a starter is again made one next, a pump relay was not controlled by one and has come.
[0045]Next, drawing 11 is a general flow chart which shows operation of the example of drawing 9, it only differs from the case of drawing 10 in that processing at Step 1308 is processing by the correlation coefficient calculation element 906 in drawing 9, and since other processings are the same, detailed explanation is omitted.
[0046]Although activation of a catalyst device is judged and he is trying to control secondary air supply by the above example appropriately, since time until a catalyst is activated has that degradation and relation, the grade of degradation of a catalyst can also be diagnosed by this time measurement.
[0047]By the way, although existence of oxygen in the inside of exhaust gas is used in the above example as description of exhaust air by the entrance side and outlet side of a catalyst device which are used for the judgment of activation of the three way component catalyst 112, it may replace with this and existence of HC (hydrocarbon) and CO (carbon dioxide) may be used.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a lineblock diagram showing an example of the engine system for cars with which one example of this invention was applied.
[Drawing 2]It is a block diagram of the control device in one example of this invention.
[Drawing 3]It is a characteristic figure showing the relation between catalyst temperature and catalyst transformation efficiency.
[Drawing 4]It is a characteristic figure for explaining operation of the oxygen sensor in one example of this invention.
[Drawing 5]It is a characteristic figure showing the relation between the catalyst temperature from an engine start time, the amount of discharge hydrocarbon, and a secondary demand air flow rate.
[Drawing 6]It is a circuit diagram showing an example of the incorporation circuit of the sensor output signal level in one example of this invention.
[Drawing 7]It is a logic lineblock diagram showing one example of this invention.
[Drawing 8]It is a timing chart for explaining operation of one example of this invention.
[Drawing 9]It is a logic lineblock diagram showing other one example of this invention.
[Drawing 10]It is a flow chart for explaining operation of one example of this invention.
[Drawing 11]It is a flow chart for explaining operation of other one example of this invention.
[Description of Notations]
100 Internal-combustion engine (engine)
101 Heat type air meter
102 Throttle valve
103 Throttle valve opening sensor
104 Idle speed control valve
105 Fuel injection valve
106 Front oxygen sensor (the 1st oxygen sensor)
107 Back oxygen sensor (the 2nd oxygen sensor)
108 Crank angle degree sensor
109 Secondary air supply cutoff valve
110 The pump for secondary air supply
111 Combustion engine control device

112 Three way component catalyst (catalyst device)
113 Exhaust pipe
114 Secondary air supply port

[Translation done.]

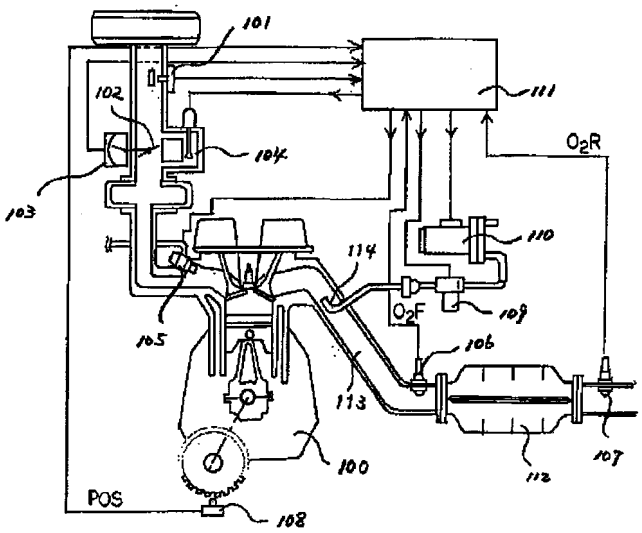
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

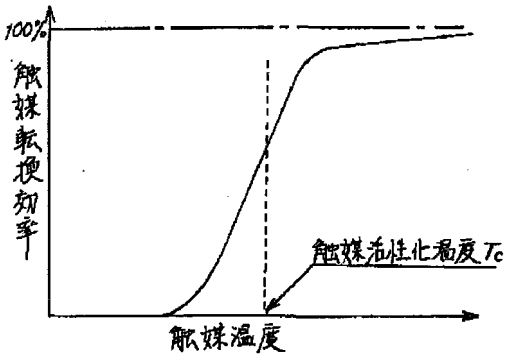
[Drawing 1]

（図　1）



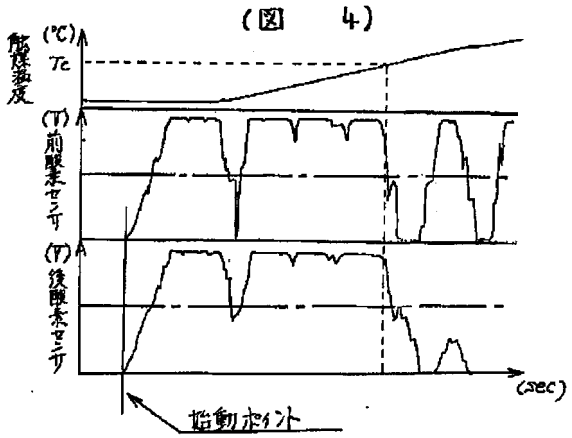
[Drawing 3]

（図　3）



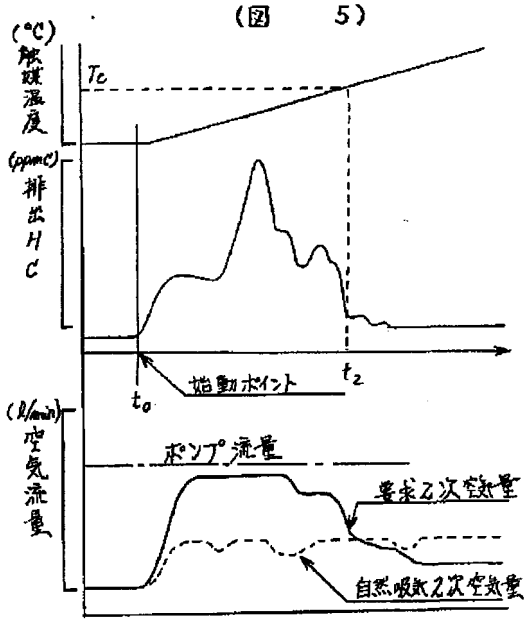
[Drawing 4]

(図 4)



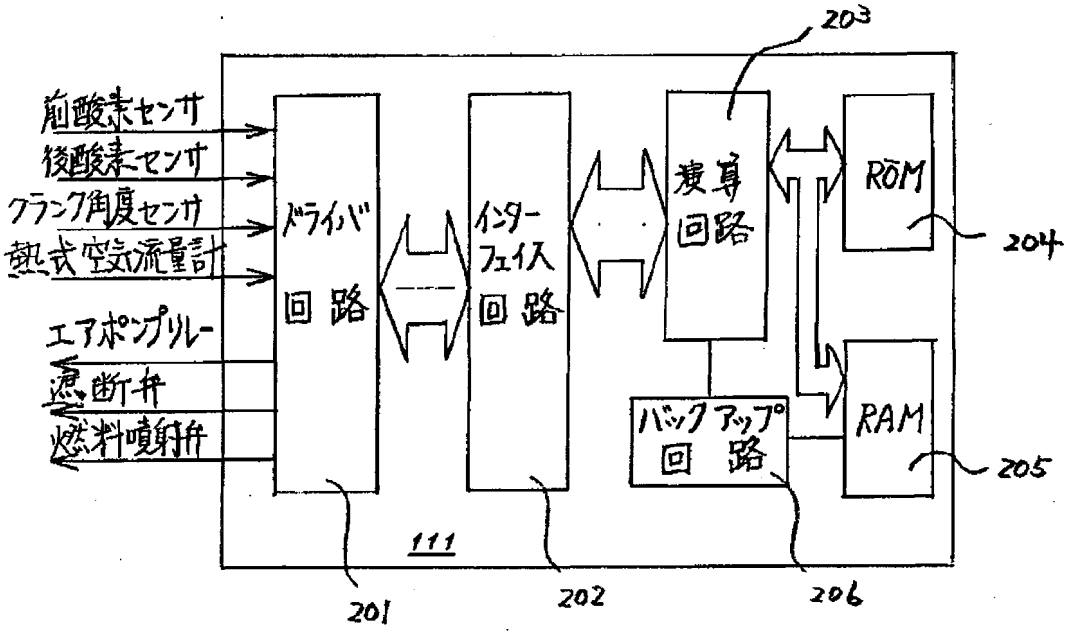
[Drawing 5]

(図 5)



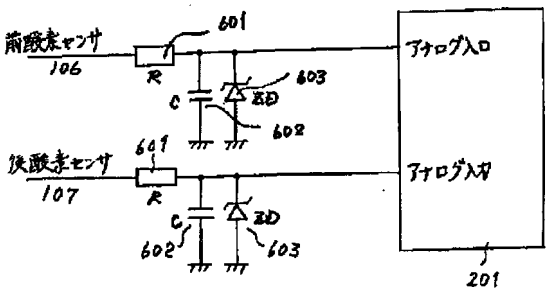
[Drawing 2]

(図 2)



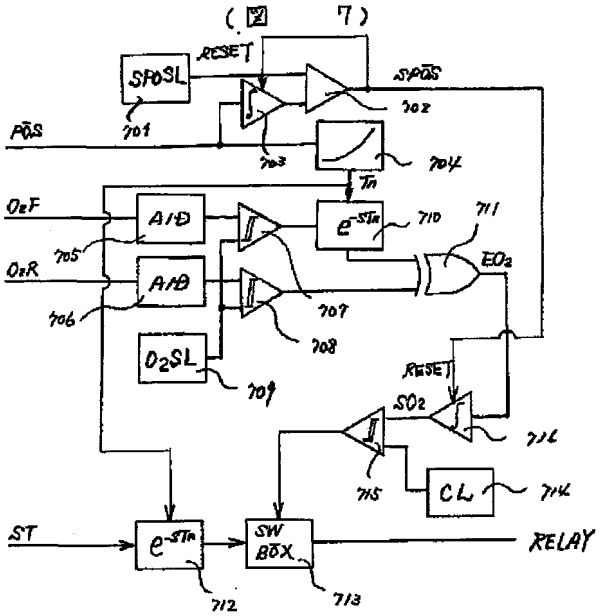
[Drawing 6]

(図 6)



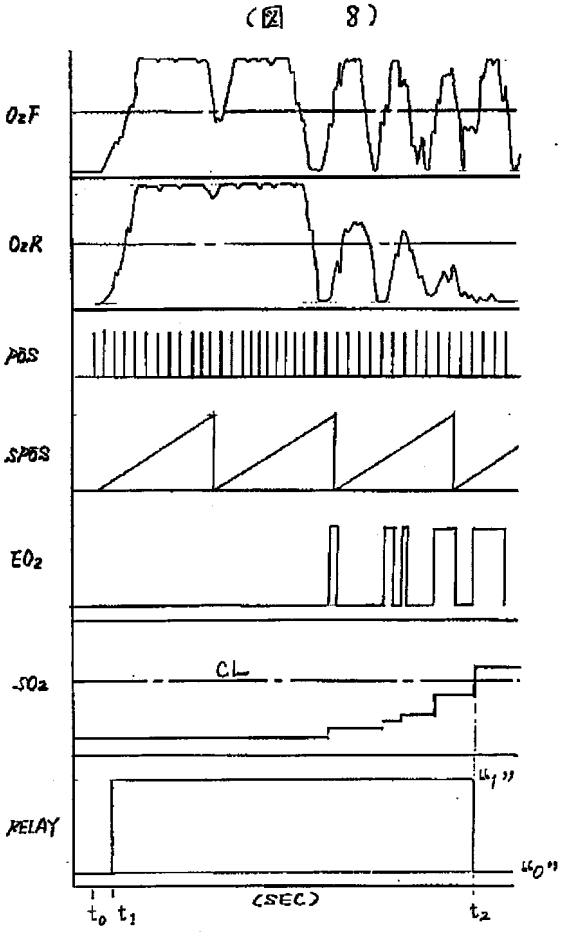
[Drawing 7]

(図 7)



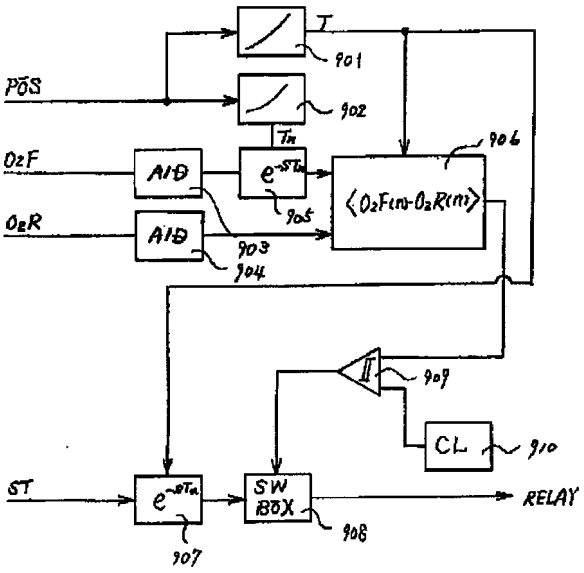
[Drawing 8]

(図 8)



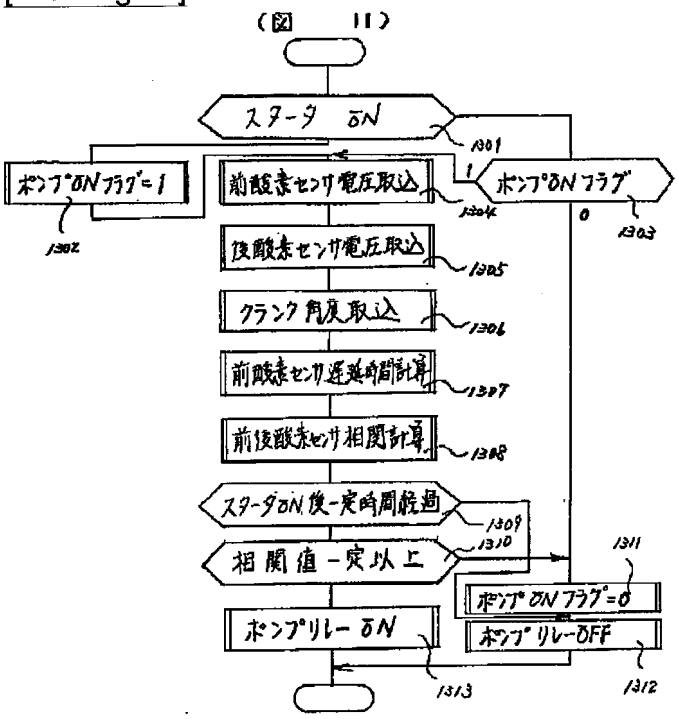
[Drawing 9]

(図　9)



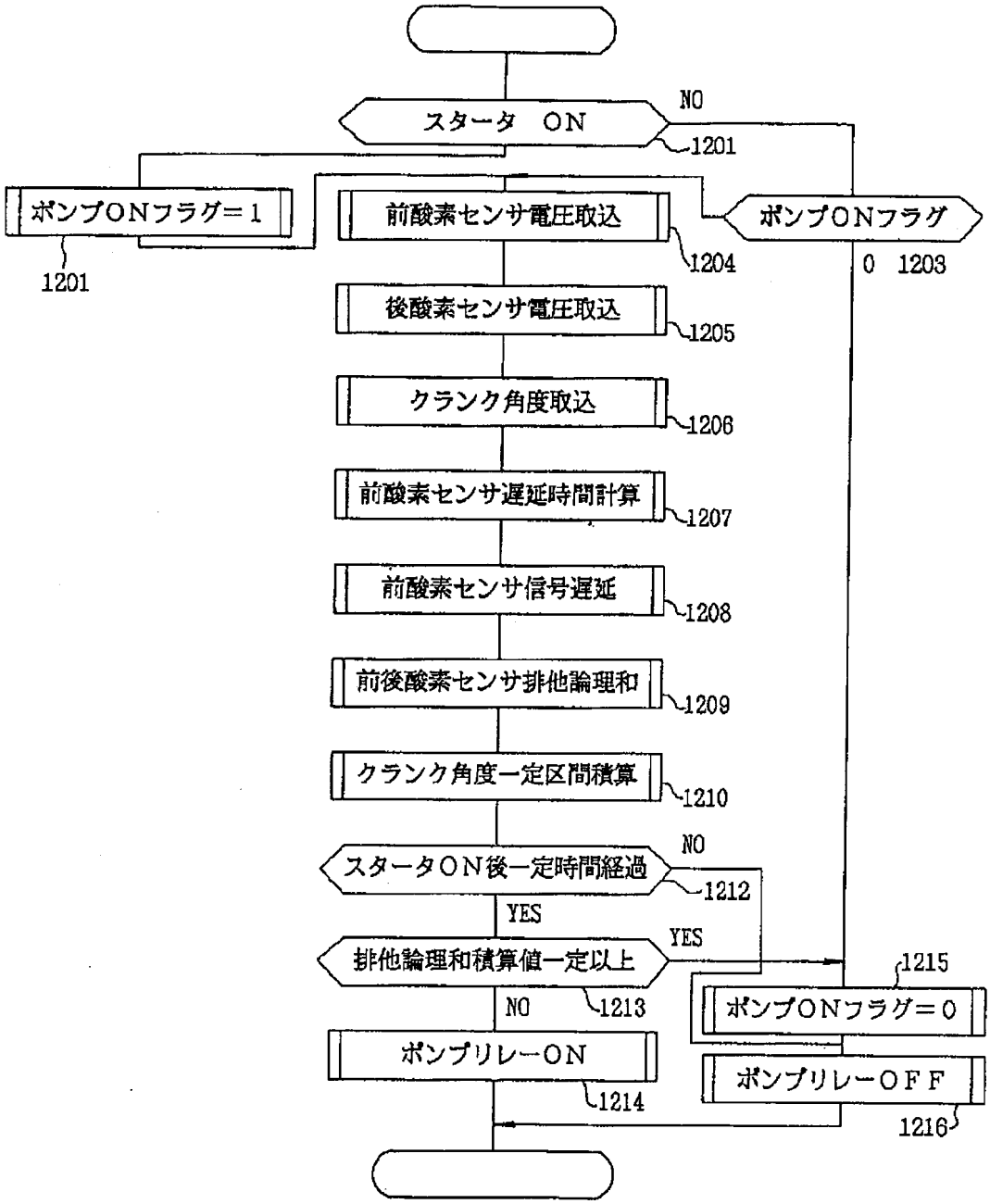
[Drawing 11]

(図　11)



[Drawing 10]

【図１０】



[Translation done.]

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最終頁に続く

(54)【発明の名称】　内燃機関の２次空気供給制御装置及びそれを備えた自動車

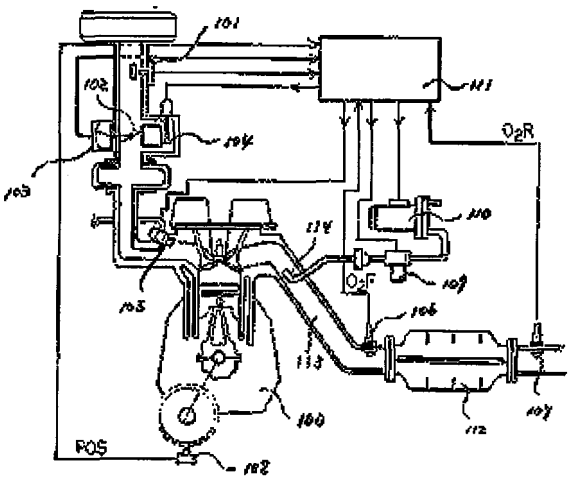
(57)【要約】

【目的】　２次空気供給手段を触媒装置の活性化に基づいて制御し、且つ、このとき、触媒装置の活性化が充分正確に判定でき、常に的確な２次空気供給量制御が得られるようにした内燃機関の２次空気供給制御装置を提供すること。

【構成】　三元触媒１１２の入口側に設置した前酸素センサ１０６と、出口側に設置した後酸素センサ１０７の信号を取り込み、制御装置１１１により、これらの信号の相関により三元触媒１１２の活性化を判定し、２次空気供給用のポンプ１１０の運転を制御するようにしたもの。

【効果】　三元触媒１１２の活性化時点を正確に知ることができるから、ポンプ１１０を的確な時点で停止させることができ、無駄なポンプの運転を確実に抑えることができる。

(図　１)



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【特許請求の範囲】

【請求項1】　排気浄化用の触媒装置と、この触媒装置を活性化するための2次空気供給手段とを備えた内燃機関において、前記触媒装置の入口側と出口側での排気の性状を比較して前記触媒装置の活性化を判定する活性化判定手段を設け、この活性化判定手段の判定結果により前記2次空気供給手段を制御するように構成したことを特徴とする内燃機関の2次空気供給制御装置。

【請求項2】　請求項1の発明において、前記排気の性状が酸素濃度であることを特徴とする内燃機関の2次空気供給制御装置。

【請求項3】　請求項2の発明において、前記酸素濃度を検出する手段が前記触媒装置の入口側と出口側の排気経路にそれぞれ設置した第1と第2の酸素センサであり、前記活性化判定手段は、これら第1と第2の酸素センサの出力の相関により活性化を判定するように構成されていることを特徴とする内燃機関の2次空気供給制御装置。

【請求項4】　請求項3の発明において、前記第1と第2の酸素センサの出力をそれぞれ2値化する第1と第2の2値化手段と、これら第1と第2の2値化手段の出力を第1と第2の入力とする排他的論理和手段とを備え、前記相関がこの排他的論理和手段の出力により与えられるように構成されていることを特徴とする内燃機関の2次空気供給制御装置。

【請求項5】　請求項1の発明において、前記活性化判定手段は内燃機関の始動開始時点を検出する手段を備え、始動開始時点から前記2次空気供給手段を動作状態に制御した後、前記活性化の判定結果が肯定状態になった時点で前記2次空気供給手段を停止状態に制御するように構成されていることを特徴とする内燃機関の2次空気供給制御装置。

【請求項6】　請求項3の発明において、前記第1と第2の酸素センサが、前記触媒装置の機能診断用の酸素センサであることを特徴とする内燃機関の2次空気供給制御装置。

【請求項7】　請求項1～6に記載の何れかの内燃機関の2次空気供給制御装置を備えた自動車。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、排気ガス浄化用の触媒装置を備え、エンジン始動時、2次空気を供給することにより、触媒装置の活性化を促進するようにした装置に係り、特に三元触媒装置を用いた自動車用エンジンシステムに好適な内燃機関の2次空気供給制御装置に関する。

【0002】

【従来の技術】排ガス浄化用の触媒装置(触媒コンバータ)が予定されている浄化機能(触媒転換効率)を発揮するためには、予じめ設定されている最低の温度(触媒活性化温度Tcという)を保つ必要があるが、この触媒装置の温度は、エンジンの運転が開始してから或る程度時間が経過したあとは、排ガスの温度により触媒活性化温度Tcに保たれるようになっている。

【0003】しかしながら、エンジン始動時直後などでは、触媒装置の温度が低く、必要な触媒転換効率を得ることができない。そこで、このようなときに、エンジンの排気中に空気(2次空気という)を供給し、これにより排気中の未燃焼ガス(ハイドロカーボン)を燃焼させ、短時間で触媒活性化温度Tcが得られるようにしている。

【0004】ところで、このような2次空気の供給による排ガス浄化を効率よく行なうためには、排気中の未燃焼ガス成分と、この2次空気との比が14．7以上であることが条件となるので、通常は、この排気中での未燃焼ガスの量を想定し、それに対して充分な量の2次空気が供給できるよう、2次空気供給用のポンプに余裕を持たせるようにしていた。

【0005】しかしながら、この場合には、実際に必要とする2次空気量とは無関係に、余裕を持った量の空気が供給されてしまうため、無駄な空気が供給されてしまうことになり、且つ容量の大きな空気ポンプが必要になるため、コストや取付スペースの増大をもたらすなどの問題がある。

【0006】そこで、例えば特開昭56－23510号公報では、排気経路の2次空気供給口下流に空燃比センサを設け、この部分での空燃比が14．7に保たれるように2次空気流量を制御する方法について開示しており、また、実開昭62－90919号公報では、触媒装置の温度を検出し、この検出した温度が所定の温度以上になったら2次空気の供給を停止する装置について開示している。

【0007】

【発明が解決しようとする課題】上記従来技術のうち、前者の方法では、空燃比センサの下流にある触媒装置内での未燃焼ガスの燃焼による触媒装置の活性化について配慮がされておらず、触媒装置が活性化された後では、過剰になった2次空気による触媒の転換効率低下の問題があり、他方、上記従来技術の内の後者の装置では、排ガスの温度による影響や、新たに温度センサを要する点についての配慮がされておらず、正確な2次空気供給時点の検出が困難で、且つコストアップになるという問題があった。

【0008】本発明の目的は、2次空気供給手段を触媒装置の活性化に基づいて制御し、且つ、このとき、触媒装置の活性化が充分正確に判定でき、常に的確な2次空気供給量制御が得られるようにした内燃機関の2次空気供給制御装置を提供することにある。

【0009】

【課題を解決するための手段】前記目的は、触媒装置の入口側と出口側で排気の性状を比較し、この比較結果か

ら触媒装置の活性化を判定する活性化判定手段を設け、この活性化判定手段の判定結果により2次空気供給手段を制御するようにしたものである。

【0010】

【作用】触媒装置が活性化されていれば、その入口側と出口側で排気の性状に予定された違いが現われる筈である。そこで、これら触媒装置の入口側と出口側での排気の性状を比較することにより活性化を正確に判定でき、この判定結果により2次空気供給手段を制御するのであるから、的確な2次空気流量制御が得られることになる。

【0011】

【実施例】以下、本発明による内燃機関の2次空気供給制御装置について、図示の実施例により詳細に説明する。図1は、本発明の一実施例が適用された自動車用エンジンシステムの一例で、この図1において、100は内燃機関(エンジン)で、これには吸入空気量の質量流量を計測する熱式空気流量計101と、吸入空気量を調整する絞り弁102、この絞り弁102の角度信号を出力する絞り弁開度センサ103、アイドル時の回転数を制御するアイドルスピードコントロールバルブ104、内燃機関に燃料を供給する燃料噴射弁105、内燃機関の回転数を検出するクランク角度センサ108、2次空気供給遮断弁109、それに2次空気供給用のポンプ110などが設けられている。

【0012】従って、ポンプ110が動作すると、これからの空気は、遮断弁109を介して排気管113の中に開口している2次空気供給口114に供給され、ここから排気管113の中に噴出して2次空気として働くようになる。そして、この時、遮断弁109は三方弁としての機能をもち、開放状態に制御されたときには2次空気供給口114をポンプ110に連通させるが、遮断状態では、空気供給口114を大気中に連通させるように動作する。

【0013】次に、111は内燃機関制御装置で、各センサからの信号を取り込み、これらの信号により内燃機関の運転状態を検出し、これらの検出結果に応じて予め定められた手順で内燃機関が要求する燃料量を計算し、燃料噴射弁105など各種のアクチュエータを駆動制御する働きをする。

【0014】また、112は三元触媒(触媒装置)で、排気ガスを酸化還元により浄化する働きをする。そして、この三元触媒112の上流には前酸素センサ(第1の酸素センサ)106が設置され、三元触媒112の入口側での排気ガス中の酸素濃度を検知する働きをし、同じく下流には後酸素センサ(第2の酸素センサ)107が設置され、三元触媒112の出口側での排気ガス中の酸素濃度を検知する働きをする。そして、これら前酸素センサ106と後酸素センサ107の出力信号は何れも制御装置111に取り込まれるようになっている。

【0015】図2は、内燃機関制御装置111の内部回路ブロックを示したもので、前述の図1における各種センサからの信号を入力し、また小信号をアクチュエータ駆動の大信号に変換する働きをするドライバ回路201、入出力信号をデジタル演算処理を行えるようアナログ－デジタル信号に変換する働きをえる入出力回路202、デジタル演算処理を行うマイクロコンピュータ、もしくはそれに準ずる演算回路を保有する演算回路203、この演算回路203の演算処理にも用いられる各種の定数や変数、及び演算手順を格納する不揮発性のメモリであるROM204と揮発性のメモリであるRAM205、それにRAM205の内容を保持するバックアップ回路206などから構成されている。

【0016】この実施例では、内燃機関制御装置111に入力される信号としては、熱式空気流量計101の検出信号と、絞り弁開度センサ103の検出信号、前酸素センサ106と後酸素センサ107の各検出信号、それにクランク角度センサ108からの検出信号などがあり、内燃機関制御装置111から出力される信号としては、燃料噴射弁105の駆動信号と点火時期信号、アイドルスピードコントロールバルブ104に対するアイドルスピードコントロール信号、ポンプ110の動作と停止を制御する2次空気供給ポンプリレー駆動信号、それに2次空気供給遮断弁109を制御する遮断弁駆動信号などがある。

【0017】図3は、三元触媒112の触媒温度と、触媒転換効率との関係を示した特性図で、この図から明らかなように、触媒転換効率は触媒活性化温度Tc の前後で急激に変化することが判る。

【0018】そこで、いま、ポンプ110を働かせ、遮断弁109を開いて2次空気を供給しながらエンジンを起動させ、三元触媒112の触媒温度の変化に対する前酸素センサ106の出力信号と後酸素センサ107の出力信号の変化をみてみると、図4に示すようになる。すなわち、この図4に示すように、触媒温度は、エンジン起動後、順次上昇してゆくが、この時、その温度が触媒活性化温度Tc に達するまでは、前酸素センサ106の出力信号と後酸素センサ107の出力信号の変化に強い相関が見られるのに対して、この触媒活性化温度Tc 以上になると、前酸素センサ106の出力信号と後酸素センサ107の出力信号の間での相関が急速に失われてゆく。

【0019】これは、三元触媒112が活性化されると、2次空気と未燃焼ガスとの触媒転換が効率的に進むようになり、この結果、三元触媒112の出口側では酸素濃度が低下してくるからである。換言すると、三元触媒112が本来の機能を発揮するようになると、その中での触媒による還元作用、或いは酸化作用などにより、入口側での排ガスの性状と、出口側での排ガスの性状が違ってくるからであり、本発明では、この触媒装置の入

口側での排ガスの性状と、出口側での排ガスの性状の違いにより、触媒装置の活性化を判定するようにしているものである。

【0020】図5は、三元触媒112の出口側における排気ガス中でのハイドロカーボンの含有量(排出HC)と、これの燃焼に必要な2次空気量の関係を示したもので、エンジンの始動時点t_0の直後は触媒温度が低いため、ハイドロカーボンは触媒内で浄化されず、このため多量の2次空気が要求される。しかし、その後、触媒温度が上昇して触媒活性化温度T_cに達した時点t_2で触媒によるハイドロカーボンの燃焼が開始し、2次空気の要求量は減少するので、ここでポンプ110を停止させ、遮断弁109を閉じて空気供給口114を大気中に連通させ、自然吸気により得られる2次空気供給量だけでハイドロカーボンの燃焼浄化が可能になることが判る。

【0021】従って、このポンプによる2次空気の供給制御のためには、この触媒が活性化温度T_cに達した時点t_2の的確な判定を要することになるが、本発明で＊

＊は、前記のように触媒装置の活性化を正確に判定でき、触媒温度が触媒活性化温度T_cに達したことを確実に検出することができるので、この判定結果により、この図5に示す、的確なタイミングでポンプ110と遮断弁109を制御するようにしたものである。

【0022】このため、図1及び図2に示す実施例では、制御装置111は、図6に示すようにして2個の酸素センサ106、107からの信号を取り込む。すなわち、前酸素センサ106と後酸素センサ107の各センサからの信号は、それぞれ抵抗601とコンデンサ602とで構成される一次遅れフィルタを通ったあと、過電圧防止用のツェナーダイオード603を介して取り込まれるのである。

【0023】こうして取り込まれた信号は、演算回路203で、次の数1に示す演算によりディジタルフィルタ処理が施される。

【0024】

【数1】

$$O_2ad(S)=\frac{1}{1+ST}\cdot O_2(S)\cdots\cdots \qquad \cdots\cdots(式1-1)$$

$$O_2ad(n)=WEIGHT\cdot O_2ad(n-1)+(1-WEIGHT)\cdot O_2(n)\cdots\cdots(式1-2)$$

【0025】この数1の式1－1は連続域でのフィルタ処理を示し、式1－2は離散域でのフィルタ処理を示している。なお、式1－2でのWEIGHTは、加重平均値による重み付けを示す。

【0026】図7は、演算回路203による2次空気供給制御処理のロジックを示したもので、この図において、POSはクランク角度信号、O_2F、O_2Rはそれぞれ前酸素センサ106と後酸素センサ107の信号であり、STはエンジン始動用スタータのON信号を示している。まず各々の酸素センサからの信号O_2F、O_2RはA／D(アナログーディジタル変換器)705、706でディジタル値に変換され、ついで比較要素707、708により閾値発生要素709から与えられている閾値O_2SLと比較され、正規化される。

【0027】次に、後酸素センサ107からの信号O_2Rは、前酸素センサ106からの信号O_2Fに比して、排ガスの触媒内での輸送遅れ分をもっているため、前酸素センサ106からの信号O_2Fは遅延要素710により、この輸送遅れ分だけ遅延される。このときの遅延時間Tnは、テーブル704をクランク角信号POSで検索して求めるようになっている。こうして処理された各々の信号O_2F、O_2Rは排他的論理和要素711に入力され、この結果、この排他的論理和要素711から相関の度合いを表わす信号、すなわち、相関信号EO_2が出力される。

【0028】排他的論理和要素711の相関信号EO_2は積分要素716により積分処理されるが、このときの積分区間は比較要素702から与えられるクランク角度の一定角度SPOSで発生するリセット信号RESETにより決められるようになっており、このため、一定角度SPOSLを発生する基準値発生要素701と、積分要素703を持ち、これらの出力を上記の比較要素702に入力するようになっている。なお、この実施例では、上記したように積分区間をクランク角度で決めるようになっているが、予め定めてある一定の時間になるようにしてもよい。

【0029】積分要素716の出力である積分信号SO_2は比較要素715に入力され、ここで閾値発生要素714から与えられている閾値CLと比較し、閾値CLを越えたら触媒が活性化されたものと判定し、比較要素715の出力信号をスイッチ要素713に供給し、これによる出力RELAYを遮断してポンプ110の運転を停止し、同時に遮断弁109を閉じて、図5の時点t_2以後の状態、すなわち、自然吸気による2次空気供給状態に制御するのである。

【0030】一方、エンジン始動時点でのスイッチ要素713による出力RELAYの立上げは、エンジン始動用スタータの信号STのON入力により与えられるが、

この実施例では、遅延要素７１２が設けてあり、この信号ＳＴについても、前述の輸送遅れに相当する遅延が与えられるようになっている。

【００３１】図８は、図７の各部分での信号のタイミングチャートで、図示してないエンジン始動用スタータ信号ＳＴが時刻t_0でＯＮしたあと、遅延要素７１２による遅延時間経過後の時刻t_1でスイッチ要素７１３による信号ＲＥＬＡＹが立上り、ポンプ１１０の運転が開始し、遮断弁１０９が開かれ、２次空気の供給が開始すそして、このとき、ポンプ１１０から２次空気が供給されていて、これによりハイドロカーボンが燃焼されるため、三元触媒１１２の温度上昇、つまり活性化が促進されるようになる。

【００３２】しかしながら、スタート時点直後では、まだ三元触媒１１２の温度が低く、常温に近い。従って、この時点以降、しばらくの間は、前酸素センサ１０６からの信号O_2Fと後酸素センサ１０７からの信号O_2Rとの相関が強く現われ(図示のように、ほとんど同じ挙動を示す)、相関信号EO_2はほとんど発生しないが、やがて三元触媒１１２の温度が上昇するにつれ、この触媒による浄化機能が働き始めるため、信号O_2Fと信号O_2Rの挙動に差が現われ、これに伴ってときどき相関信号EO_2が発生し、少しづつ積分信号SO_2が増加してゆくようになる。

【００３３】そして、三元触媒１１２が活性化される＊と、図示のように、信号O_2Fと信号O_2Rの相関はほとんど失われてしまうので、積分信号SO_2のレベルは急激に増大し、それが閾値ＣＬを越えた時刻t_2で比較要素７１５から信号が発生し、これによりスイッチ要素７１３から出力されていた信号ＲＥＬＡＹが立ち下がるので、この時刻t_2、すなわち、三元触媒１１２が活性化されたところで確実にポンプ１１０の運転が停止され、遮断弁１０９が閉じられることになり、常に的確なタイミングでポンプ１１０の運転が停止できるから、無駄なポンプの運転を確実に抑えることができる。

【００３４】次に、図９により本発明の他の実施例について説明する。この図９の実施例は、相関係数計算方式を応用して触媒装置の活性化を判定するようにしたもので、各酸素センサからの信号O_2F、O_2Rは、図７の実施例と同様に、それぞれＡ／Ｄ９０３、９０４でディジタル値に変換される。そして、前酸素センサ１０６からの信号O_2Fには遅れ要素９０５により、輸送遅れ補正を施す。このときの遅延時間Ｔｎは、やはり図７の実施例と同様に、テーブル９０２をクランク角信号ＰＯＳで検索して求めるようになっている。

【００３５】９０６は相関係数計算要素で、つぎに示す数２により各酸素センサからの信号O_2F、O_2Rの相関を計算する。

【００３６】

【数２】

$$\langle O_2F(\tau)\cdot O_2R(\tau)\rangle=\int_{-\infty}^{\infty} O_2F(t)\cdot O_2S(t+\tau)\,dt \quad \cdots\cdots$$

$\cdots\cdots$(式２－１)

$$\langle O_2F(m)\cdot O_2R(m)\rangle=\frac{1}{D\cdot\sigma_{O_2F}\cdot\sigma_{O_2R}}\sum_{n=0}^{D-1} O_2F(n)\cdot O_2R(n+m)$$

$\cdots\cdots$(式２－２)

$$D=f(N)=T \quad \cdots\cdots$$

$\cdots\cdots$(式２－３)

【００３７】この数２において、式２－１は連続域での計算式であるが、この実施例では、図２に示すように、ディジタル演算処理が採用されているので、式２－２に示す離散域での計算式を用いて計算するようになっている。そして、このときの計算区間Ｄは、式２－３に示すように、エンジンの回転数Ｎの関数で与えられるようになっており、このため、テーブル９０１をクランク角信号ＰＯＳで検索して求めるようになっている。

【００３８】こうして相関係数計算要素９０６で計算された相関係数は、やはり図７の実施例と同様に、比較要素９０９により、閾値発生要素９１０から与えられている閾値ＬＣと比較され、閾値ＣＬを越えたら触媒が活性化されたものと判定し、比較要素９０９の出力信号をスイッチ要素９０８に供給し、これによる出力ＲＥＬＡＹを遮断してポンプ１１０の運転を停止し、同時に遮断弁１０９を閉じて、図５の時点t_2以後の状態、すなわち、自然吸気による２次空気供給状態に制御するのである。

【００３９】一方、エンジン始動時点でのスイッチ要素９０８による出力ＲＥＬＡＹの立上げは、エンジン始動用スタータの信号ＳＴのＯＮ入力により与えられるが、この実施例でも、図７の実施例と同じく、遅延要素９０

7により、この信号STについても、前述の輸送遅れに相当する遅延が与えられるようになっている。

【0040】従って、この図9の実施例によっても、三元触媒112の活性化を正確に判定することができ、2次空気供給用のポンプ110と遮断弁109の的確な制御を得ることができる。

【0041】次に、以上の実施例の動作を、フローチャートにより詳細に説明する。まず、図10は、図7の実施例の動作を示すジェネラルフローチャートで、ステップ1201でエンジンのスタータがオンになっているか否かを判定する。そして、オンになっていたらステップ1202でポンプONフラグを1にする。

【0042】以下、ステップ1204からステップ1211までの処理を順次実行する。すなわち、前後の各酸素センサの出力電圧をA／Dから取り込む(ステップ1204、1205)。クランク角信号POSを取り込み(ステップ1206)、エンジンの回転数を計算して前酸素センサの信号に施すべき遅延時間を計算し(ステップ1207)、信号を遅延させる(ステップ1208)。

【0043】ステップ1209では、各酸素センサからの処理済の信号の排他的論理和をとり、ステップ1210で一定のクランク角度時間の積分を行ない、ステップ1213でこの積算結果が所定値(閾値)以下のときにはステップ1214でポンプ110と遮断弁109を制御するリレー(ポンプリレー)をオンにするのであるが、このとき、ステップ1212でスタータがオンになってから予じめ定めてある一定時間が経過したか否かを調べるようになっている。これは、図7の遅延要素712による機能、すなわち、スタータによるエンジン始動開始と同時に2次空気供給用のポンプ110をオンにするのではなく、遅延させてオンさせるためで、この遅延時間は、図7の実施例のように、エンジンの回転数をパラメータとして、或いはエンジンの温度をパラメータとして与えられるようになっている。

【0044】一方、ステップ1212で一定時間経過していないと判断されたときには、ステップ1216でポンプリレーをオフして処理を終了するのである。また、ステップ1213で積算値が閾値以上であると判断されたときにはステップ1215でポンプONフラグを0にし、続いてステップ1216でポンプリレーをオフし、処理を終了するのである。他方、この実施例では、ステップ1203が設けてあり、これにより、次に再びスタータがオンにされない限りはポンプリレーがオンに制御されないようになっている。

【0045】次に、図11は、図9の実施例の動作を示すゼネラルフローチャートで、ステップ1308での処理が図9での相関係数計算要素906による処理になっている点が、図10の場合と異なるだけで、その他の処理は同じであるから、詳しい説明は割愛する。

【0046】なお、以上の実施例では、触媒装置の活性化を判定して、2次空気の供給を適切に制御するようにしているが、触媒が活性化されるまでの時間は、その劣化と関連があるので、この時間の測定により触媒の劣化の程度を診断することもできる。

【0047】ところで、以上の実施例では、三元触媒112の活性化の判定に使用する触媒装置の入口側と出口側での排気の性状として、排ガス中での酸素の存在を用いているが、これに代えてHC(ハイドロカーボン)やCO(二酸化炭素)の存在を用いてもよい。

【0048】

【発明の効果】本発明によれば、触媒装置の入口側と出口側で排気の性状を比較し、この比較結果から触媒装置の活性化を判定するようにしたので、エンジンの運転状態などの影響を受けることなく常に正確な判定結果を得ることができ、この結果、2次空気供給用のポンプの運転を常に的確なタイミングで確実に停止制御でき、無駄な運転を抑えることができる。

【0049】また、本発明によれば、触媒装置の活性化を判定して2次空気の供給を制御しているので、2次空気供給用のポンプの容量が低減でき、小型化、軽量化が可能になり、且つコストも低減化することができる。

【0050】さらに、本発明によれば触媒装置自体で、自身の活性化を判定するようにしたインテリジェント化された装置とすることも可能になり、自動車用などとしてシステムの一層の簡略化を図ることができる。

【図面の簡単な説明】

【図1】本発明の一実施例が適用された自動車用エンジンシステムの一例を示す構成図である。

【図2】本発明の一実施例における制御装置のブロック図である。

【図3】触媒温度と触媒転換効率との関係を示す特性図である。

【図4】本発明の一実施例における酸素センサの動作を説明するための特性図である。

【図5】エンジン始動時からの触媒温度と排出ハイドロカーボン量及び要求2次空気流量の関係を示す特性図である。

【図6】本発明の一実施例におけるセンサ出力信号電圧の取り込み回路の一例を示す回路図である。

【図7】本発明の一実施例を示すロジック構成図である。

【図8】本発明の一実施例の動作を説明するためのタイミングチャートである。

【図9】本発明の他の一実施例を示すロジック構成図である。

【図10】本発明の一実施例の動作を説明するためのフローチャートである。

【図11】本発明の他の一実施例の動作を説明するためのフローチャートである。

【符号の説明】

11

100　内燃機関(エンジン)
101　熱式空気流量計
102　絞り弁
103　絞り弁開度センサ
104　アイドルスピードコントロールバルブ
105　燃料噴射弁
106　前酸素センサ(第1の酸素センサ)
107　後酸素センサ(第2の酸素センサ)

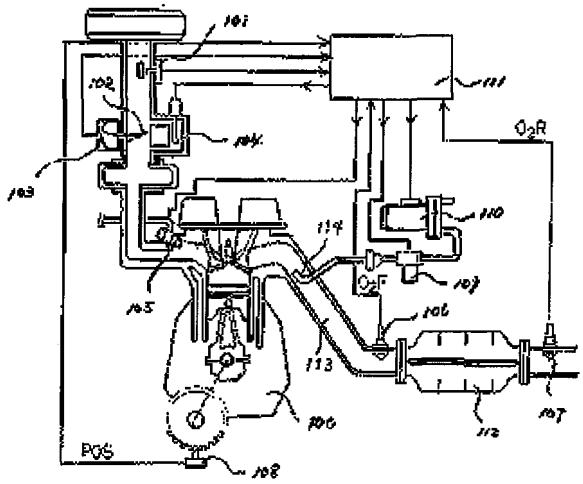
12

＊108　クランク角度センサ
109　2次空気供給遮断弁
110　2次空気供給用のポンプ
111　内燃機関制御装置
112　三元触媒(触媒装置)
113　排気管
114　2次空気供給口

＊

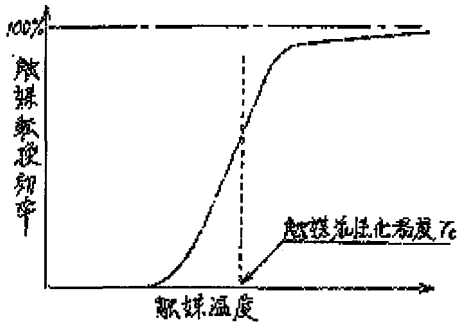
【図1】

(図　1)



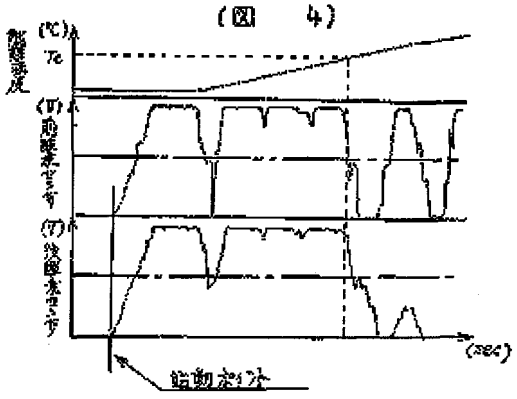
【図3】

(図　3)



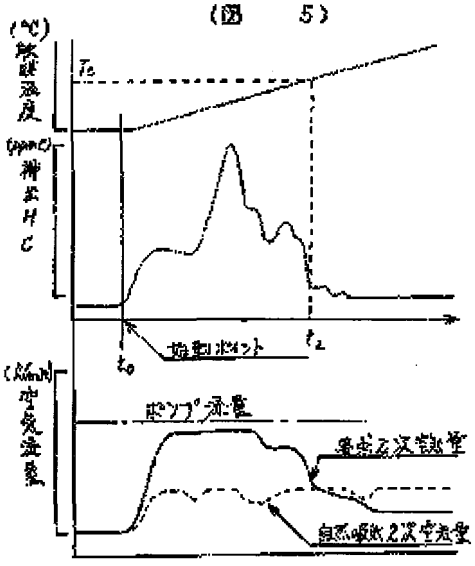
【図4】

(図　4)



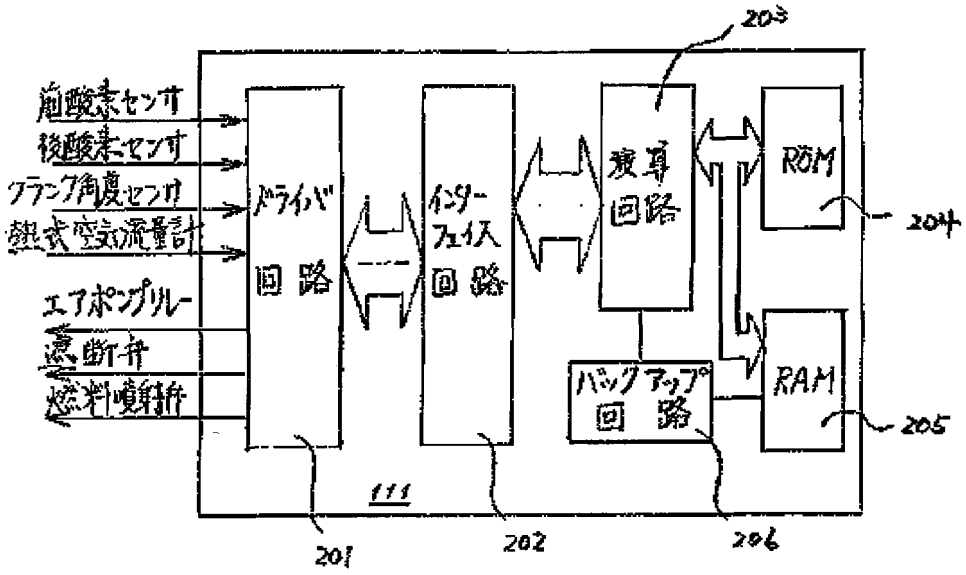
【図5】

(図　5)



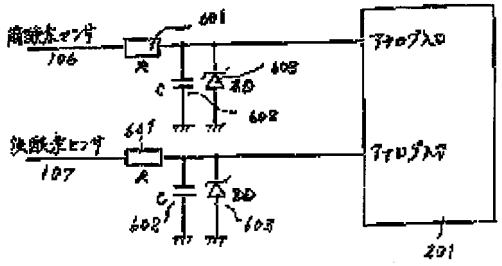
【図2】

（図　2）

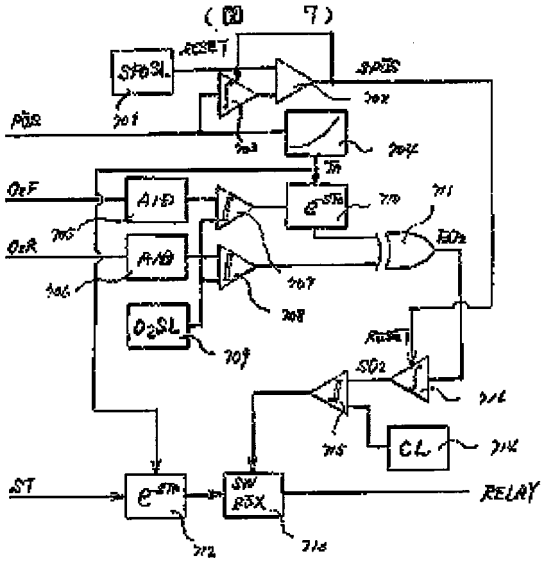

前酸素センサ
後酸素センサ
クランク角度センサ
熱式空気流量計
エアポンプリレー
遮断弁
燃料噴射弁
ドライバ回路
インターフェイス回路
演算回路
ROM
RAM
バックアップ回路
203
204
205
206
111
201
202

【図6】

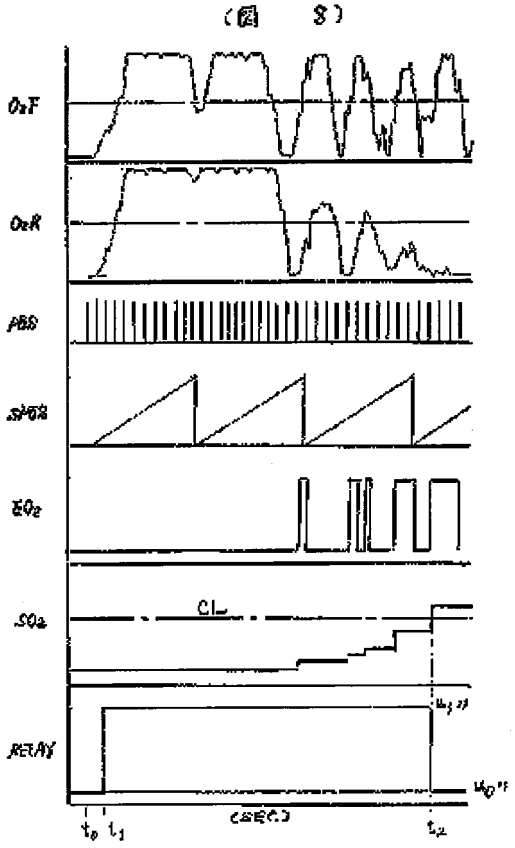
（図　6）


前酸素センサ
106
601
R
C
LD
602
後酸素センサ
107
603
アナログ入力
201

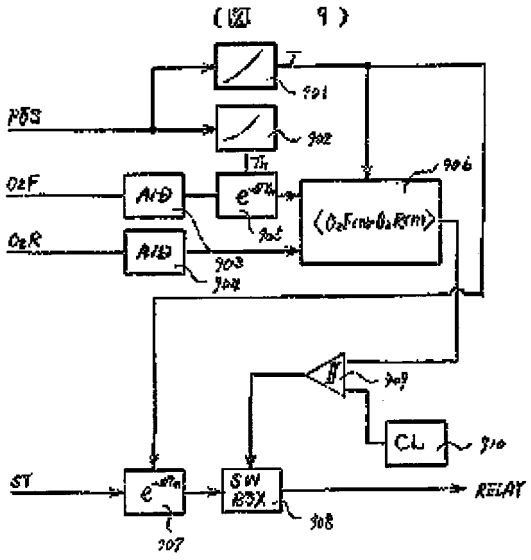
【図７】


(図 7)
RESET
SPEED
PBS
O2F
O2R
A/D
CL
ST
SW
RELAY

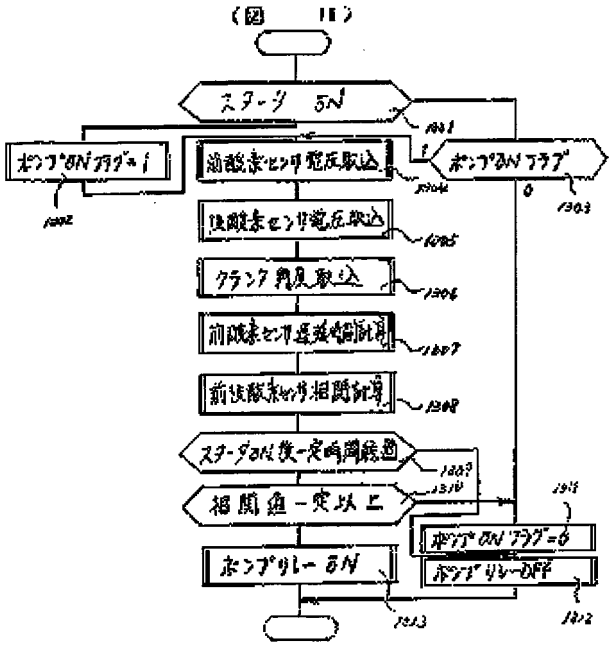
【図８】


(図 8)
O2F
O2R
PBS
SPEED
SO2
CL
RELAY
SEC

【図９】

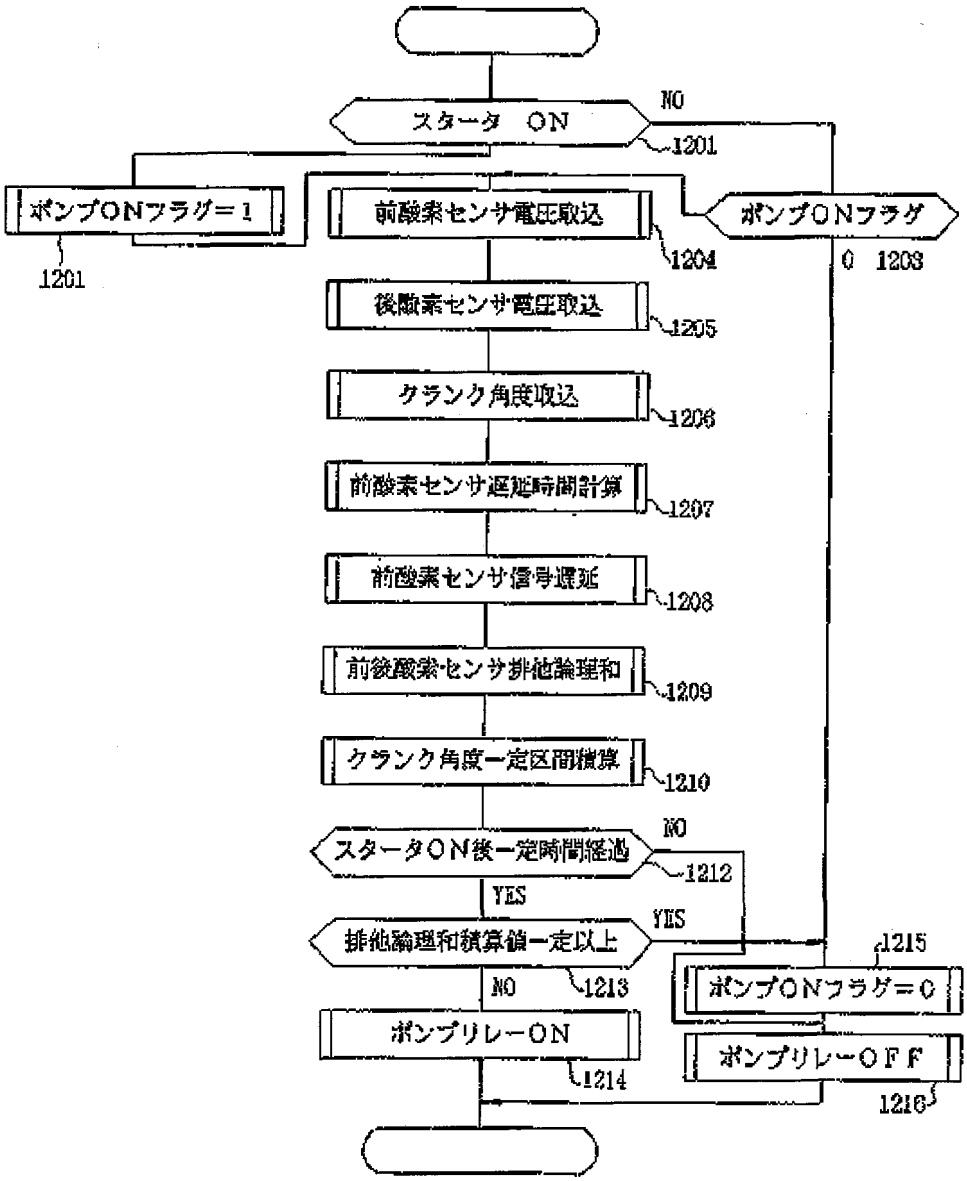

(図 9)
PBS
O2F
O2R
A/D
CL
ST
SW
RELAY

【図１１】


(図 11)
スタータ ON
ポンプON フラグ=1
ポンプON フラグ
ポンプON フラグ=0
ポンプリレー ON
ポンプリレー OFF

【図１０】

【図１０】



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